

CLAIMS:

1. A process of separating a purified propylene oxide from a propylene oxide reaction product, the process comprising:

5 (a) introducing a reaction product comprising from about 65 to 88 percent propylene oxide, from about 10 to 35 percent methanol, and less than about 0.5 percent water into a bottom section of an extractive distillation zone;

(b) introducing water into an intermediate section of said extractive distillation zone;

10 (c) removing from said extractive distillation zone under distillation conditions a bottoms stream comprising propylene oxide, water, and methanol,

(d) removing from said extractive distillation zone under distillation conditions, an overhead or side-cut stream, comprising a purified propylene oxide essentially devoid of methanol and water; the extractive distillation conditions being sufficient to maintain a yield loss of propylene oxide of less than about 0.3 mole percent.

15 2. The process of Claim 1 wherein the propylene oxide reaction product fed to the extractive distillation zone additionally comprises less than 2 percent propylene and/or from about 0.1 to 0.5 percent acetaldehyde, by weight.

20 3. The process of Claim 1 wherein the extractive distillation zone contains from greater than about 30 to less than about 100 theoretical stages.

4. The process of Claim 1 wherein the propylene oxide reaction product is fed to the bottom 1/4 of the extractive distillation zone, measured as theoretical stages from the bottom to the top of the extractive distillation zone.

25 5. The process of Claim 1 wherein water is introduced into the upper-half section of the extractive distillation zone.

6. The process of Claim 1 wherein the extractive distillation zone is operated at a water to purified propylene oxide (PO) stream ratio of greater than about 1:20 and less than about 1:5, by weight.

30 7. The process of Claim 1 wherein the distillation zone is operated at an overhead temperature of greater than about 35°C and less than about 45°C.

8. The process of Claim 1 wherein the distillation zone is operated at a bottoms temperature of greater than about 55°C and less than about 75°C.

9. The process of Claim 1 wherein the distillation zone is operated at a pressure of greater than about 0.5 bar (50 kPa) and less than about 2 bar (200 kPa).

10. The process of Claim 1 wherein a bottoms stream is obtained that comprises the following components, in percentages by weight: from about 20 to 40 percent propylene oxide, from about 40 to 60 percent methanol, from about 10 to 25 percent water, from about 0.05 to 0.3 percent propylene glycol, and from about 0.1 to 0.2 percent other glycols and heavies.

11. The process of Claim 1 wherein the purified propylene oxide overhead or side-cut stream comprises the following components, in percentages by weight: greater than about 99.5 percent propylene oxide, no greater than about 50 ppm methanol, and no greater than about 100 ppm water.

12. The process of Claim 1 wherein the yield loss of propylene oxide to propylene glycol and other glycol heavies is less than about 0.2 mole percent.

13. The process of Claim 1 wherein the propylene oxide obtained as an overhead or side-cut stream from the extractive distillation zone is distilled to yield a purified propylene oxide meeting commercial grade purity standards.

14. The process of Claim 13 wherein the purified propylene oxide meeting commercial grade standards of purity is comprised of the following components, in percentages by weight: propylene oxide, greater than 99.95 percent; no greater than 100 ppm water; no greater than 10 ppm methanol; and no greater than 30 ppm aldehydes.

15. The process of Claim 1 wherein the propylene oxide reaction product is obtained from a process comprising contacting propylene with hydrogen peroxide in a liquid phase in methanol solvent and in the presence of an epoxidation catalyst under epoxidation conditions.

16. A process of separating a purified propylene oxide product obtained from the reaction of propylene with hydrogen peroxide in the presence of a titanium-containing catalyst, the separation-purification process comprising:

(a) introducing an epoxidation product comprising from about 65 to 88 percent propylene oxide, from about 10 to 35 percent methanol, and less than about 0.5 percent water, by weight, to about the first to fifth theoretical stage measured from the bottom of an extractive distillation zone;

(b) introducing water into the upper-half of the extractive distillation zone;

(c) maintaining the extractive distillation zone at a bottoms temperature greater than about 55°C and less than about 75°C, so as to remove from said extractive distillation zone under extractive distillation conditions a bottoms stream comprising from about 20 to 40 percent propylene oxide, from about 10 to 25 percent water, and from about 40 to 60 percent methanol, by weight, and;

(d) removing from said extractive distillation zone an overhead or side-cut stream comprising greater than 99.5 percent propylene oxide, no greater than about 100 ppm water, and no greater than about 50 ppm methanol, by weight; while maintaining a yield loss of propylene oxide of less than about 0.3 mole percent.

17. A process of separating a purified propylene oxide from an epoxidation reaction product, the process comprising:

(a) distilling in a first distillation zone a crude propylene oxide reaction product comprising propylene oxide, methanol, water, acetaldehyde, and unreacted propylene to obtain a first bottoms stream comprising a portion of the methanol, water, and acetaldehyde, and a first overhead stream comprising propylene oxide and unreacted propylene and the balance of the methanol, water, and acetaldehyde;

(b) distilling in a second distillation zone the first overhead stream of step (a) to remove unreacted propylene and to recover a second bottoms stream comprising from about 65 to 88 percent propylene oxide, from about 10 to 35 percent methanol, less than about 0.5 percent water, and from about 0.1 to 0.5 percent acetaldehyde, and less than 2 percent unreacted propylene, by weight;

(c) feeding the second bottoms stream obtained from step (b) to the bottoms section of an extractive distillation column and subjecting said stream to extractive distillation with water as the extraction solvent under extractive distillation conditions sufficient to obtain a third bottoms stream comprising propylene oxide, water, and methanol; optionally, a top stream comprising unreacted propylene; and a third overhead distillate or side-cut stream comprising a purified propylene oxide containing residual acetaldehyde but essentially devoid of water, methanol, and unreacted propylene, while maintaining a yield loss of propylene oxide in the extractive distillation step (c) of less than 0.3 mole percent;

(d) optionally, recycling the third bottoms stream from step (d) to step (a);

(e) optionally, recycling the top stream from step (c) to step (b); and

(f) optionally, distilling the third overhead or side-cut distillate stream from step (c) to remove any residual acetaldehyde and to obtain a purified propylene oxide of commercial grade purity.

18. The process of Claim 17 wherein the crude propylene oxide is obtained in an epoxidation process comprising reacting propylene with hydrogen peroxide in the presence of a titanium-containing catalyst.

19. The process of Claim 17 wherein the crude propylene oxide epoxidation product comprises the following composition in percentages by weight: from about 3 to 35 percent propylene oxide, from about 35 to 80 percent methanol, from about 8 to 40 percent water, from about 0.5 to 15 percent propylene, and less than about 0.1 percent acetaldehyde.

20. The process of Claim 18 wherein the epoxidation catalyst is a titanium silicate.

21. An apparatus for separating and purifying a crude propylene oxide reaction product, the apparatus comprising:

(a) a first distillation tower into which a crude epoxidation product comprising propylene oxide, methanol, water, acetaldehyde, unreacted propylene is fed; said first tower functioning to remove a portion of the methanol, water, and acetaldehyde in a first bottoms stream and to produce a first overhead stream comprising propylene oxide and unreacted propylene and the balance of methanol, water, and acetaldehyde;

(b) a second distillation tower into which the first overhead stream is fed; said second tower functioning to remove substantially unreacted propylene and to produce a second bottoms stream comprising from about 65 to 88 percent propylene oxide, from about 10 to 35 percent methanol, less than about 0.5 percent water, from about 0.1 to about 0.5 percent acetaldehyde, and less than about 2 percent unreacted propylene;

(c) a third distillation tower into which the second bottoms stream is fed and into which an extractive solvent is fed; said third tower functioning as an extractive distillation zone to remove essentially all of the remaining methanol and water, so as to produce a third bottoms stream comprising methanol and water; a third overhead or a side-cut stream comprising a purified propylene oxide containing residual acetaldehyde but essentially devoid of water and methanol; and optionally, a top stream comprising residual unreacted propylene;

(d) optionally, a means for recycling the third bottoms stream to the first distillation tower;

(e) optionally, a means for recycling the third overhead stream to the second distillation tower; and

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(f) optionally, a fourth distillation tower into which the third overhead or side-cut stream is fed; said fourth tower functioning to remove any residual acetaldehyde and to produce a purified propylene oxide meeting commercial grade purity standards.